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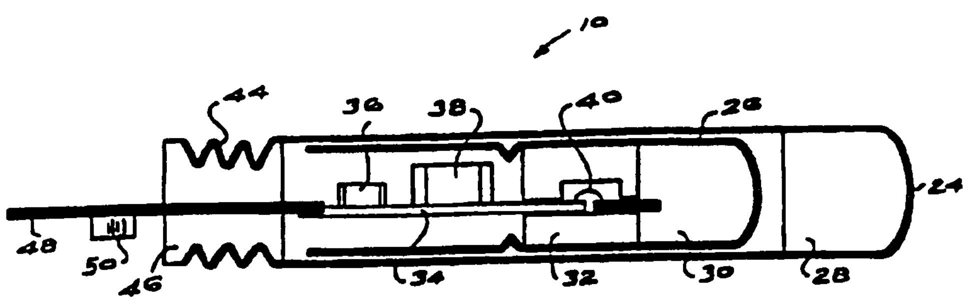

(57) Abstract

An electronic explosives initiating device which includes a firing element which has a designed no-fire voltage and an operating circuit which operates at any voltage in a range of voltages which straddles the designed no-fire voltage.

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ELECTRONIC EXPLOSIVES INITIATING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to an electronic explosives initiating device and to a system which includes one or more of the devices.

The invention is concerned particularly with a system which enables detonating devices to be identified in the field, even though labels or identity markings on the devices may have been removed or obliterated, so that the devices can be assigned definite time delays, wherein the integrity of the connections of the respective devices to a blasting harness can be rapidly and easily determined, and which offers a high degree of safety to personnel installing the system.

SUMMARY OF THE INVENTION

The invention provides, in the first instance, an electronic explosives initiating device which includes a firing element which has a designed no-fire voltage and an operating circuit which operates at any voltage in a range of voltages which straddles the designed no-fire voltage.

The designed no-fire voltage may be verified by testing one or more samples taken from a batch of electronic explosives initiating devices which are designed to be substantially the same due to the use of similar techniques in their manufacture.

The operating circuit may include any appropriate control or communication or other feature.

In one example of the invention the device includes a bi-directional communication circuit which operates at a voltage below the no-fire voltage.

Preferably the bi-directional communication circuit operates at any voltage in a range of voltages which straddles the no-fire voltage.

A unique identity or serial number may be assigned to the device and the operating circuit may include memory means for storing the number.

The operating circuit may be adapted automatically to transmit preprogrammed data, which may include the aforementioned number, in response to a particular interrogating signal, or after the detonator is powered up.

The device may be configured so that the operating circuit, when connected to an operating voltage which is in the said range and which is below the designed no-fire voltage, is in a linked state in which identity data, pertaining to the device and stored in the circuit, can be logged. Preferably the operating circuit, when connected to the operating voltage, is responsive to an externally applied control signal by means of which the operating circuit can be switched to an unlinked state.

The device may include at least one structure, adjacent the firing element, which is more susceptible to mechanical damage than the firing element.

The firing element may be any appropriate mechanism and may, for example, be a semiconductor component, be formed by a bridge, or consist of any other suitable mechanism.

For example in the case where use is made of a bridge as the firing element one or more links which are physically less robust than the bridge may be positioned

adjacent the bridge and may be monitored electrically, or in any other way, for mechanical damage. The operating circuit may for example include means for monitoring the link or links and for rendering the bridge inoperative if mechanical damage to the link or links is detected.

The device may include means for sensing the polarity of any electrical connection made to the device and for resolving the polarity of the connection.

The device may have a label attached to it which displays a number or code which corresponds to or which is based on the aforementioned unique number in the memory means. The device may have a label attached to it, for example on its lead wires, which is readable either electronically, mechanically or optically.

The device may include a sensing circuit which monitors a voltage applied to the device and which generates a warning signal if the voltage exceeds a pre-determined level. Alternatively or additionally the voltage may be clamped to a level below the no-fire voltage.

The invention also extends to a blasting system which includes one or more of the aforementioned devices and at least a first control unit which does not have an internal power source and which is adapted to record the identity data of each device connected to it in a predeterminable order.

The system may include a second control unit which is used to assign a respective time delay to each of the devices via the first control unit. Use may be made of the identity data recorded in the first control unit in order to associate an appropriate time delay with each respective device.

The invention further extends to an electronic explosives initiating device which includes a firing element which has a designed no-fire voltage and which has

been tested at a confirmation no-fire voltage which is less than the designed no-fire voltage, the device further including an operating circuit which operates at any voltage in a range of voltages which straddles the designed no-fire voltage, and memory means in which identity data, pertaining to the device, is stored, the operating circuit, when connected to an operating voltage which is in the said range and which is below the designed no-fire voltage, being switchable to a linked state in which the identity data can be accessed by external means.

The invention also provides a blasting system which incudes a plurality of explosives initiating devices, each device including respective memory means in which identity data, pertaining to the device, is stored, and a respective operating circuit, control means, and connecting means, leading from the control means, to which each of the devices is separately connectable, the control means including test means for indicating the integrity of the connection of each device to the connecting means, when the connection is made, and storage means for storing the identity data from each device and the sequence in which the devices are connected to the connecting means.

The invention also provides a method of establishing a blasting system which includes the steps of connecting a plurality of explosives initiating devices, at respective chosen positions, to connecting means extending from control means, testing the integrity of each connection at the time the connection is made, storing in the control means identity data pertaining to each respective device and the sequence in which the devices are connected to the connecting means, and using the control means to assign predetermined time delays to the respective devices.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 is a graphical presentation of voltage characteristics of an electronic explosives initiating device according to the invention,

Figure 2 is a cross-sectional view through a detonator which includes an initiating device according to the invention,

Figure 3 is a plan view of portion of the detonator of Figure 2, on an enlarged scale,

Figure 4 is a side view of the detonator shown in Figure 3,

Figure 5 is an end view of the detonator shown in Figure 3,

Figure 6 is a view on an enlarged scale of an initiating device according to the invention including its associated integrated circuit,

Figure 7 is a block circuit diagram of the initiating device of the invention,

Figure 8 is a block circuit diagram of a modified initiating device according to the invention, and

Figures 9 and 10 respectively depict different phases in the use of a plurality of devices in a blasting system.

DESCRIPTION OF PREFERRED EMBODIMENT

No-fire current is a well known detonator bridge characteristic. With a well defined firing circuit such as may be implemented with the use of microchip technology the firing circuit inherently has a highly reproducible resistance and the no-fire voltage is therefore predictably related to the no-fire current. The no-fire voltage is inherent in the construction of the bridge, and does not rely on the correct functioning of any other circuits or components.

Figure 1 illustrates the voltage characteristics of an electronic explosives initiating device according to the invention. The device has a designed no-fire voltage V_{NF} at an intermediate level in the range of from 0 to 30 volts. Samples taken from a plurality of devices manufactured under substantially similar conditions are tested to establish a voltage at which no devices fire. The remaining devices in the batch are then assumed to have the tested no-fire voltage.

As indicated in Figure 1 a voltage below the designed no-fire voltage is insufficient to fire the device, while above the designed no-fire voltage, the device may be ignited by sending the correct control sequences. Operating and bi-directional communication circuits, associated with the device, do however function at any voltage in a range of voltages which straddles the designed no-fire voltage and which extends from below to above the designed no-fire voltage.

The designed no-fire voltage is the voltage which is applied to the terminals of the device.

In production the designed no-fire voltage of every device produced is in fact confirmed to be above a particular limit as a result of a test that is performed on every one of the devices being produced, during which test the devices are powered up to the voltage level indicated in Figure 1 and all circuits are operated in an attempt to fire the devices. All devices that do not fire pass the test. This ensures that any devices connected into a live circuit at the safe testing voltage will not detonate under any signal conditions.

Figures 2 to 5 illustrate a detonator 10 made using an electronic explosives initiating device 12 of the kind shown in Figure 6. The last mentioned Figure shows an integrated circuit 14 with a bridge firing element 16 connected to the circuit via a firing switch 18. Adjacent the bridge firing element is a relatively thin

and mechanically weaker conductor 20, used as a sensor, also referred to as a guard ring. Connections to the circuit are achieved via terminals 22.

Figures 2 to 5 show the mechanical relationship of the components in the detonator, and certain electrical connections. The detonator includes a tubular housing 24 in which are located an intermediate housing 26 and a base charge 28 consisting for example of PETN or TNT.

The intermediate housing carries a primary explosive 30 such as DDNP, lead styphnate, lead azide or silver azide, a header 32, a substrate 34, resistors 36 and a capacitor 38. Using bridges with enhanced output as contemplated in SA patent No. 87/3453 the intermediate housing may be filled with secondary explosives such as PETN or RDX.

The header 32 is a substrate which does not carry a circuit pattern. Located in it, however, as is more clearly illustrated in Figure 4, is the integrated circuit 12 which constitutes the electronic explosive initiating device of the invention.

The substrate 34 carries a printed circuit pattern, see Figure 3, and, as has been noted, relatively bulky components such as the resistors 36 and the capacitor 38 are mounted to the substrate.

Electrical interconnections between the header 32 and the substrate 34 are made by means of flexible bonding wires 40. Alternatively flip-chip and tape automated bonding techniques may be used to effect the electrical connections.

The housing 24 is crimped at one end 44 to a crimp plug 46 which also acts as a seal to protect the components inside the housing 24 against the ingress of moisture and dirt. Electrical leads 48 extending from the substrate 34 carry a label 50. A unique identity number associated with the detonator is carried in bar

code form on the label. This number corresponds to or is associated with a number stored in the circuit 14 of the device 12.

Figure 7 is a block diagram of the circuit 14. The circuit includes the following principal components: a bridge rectifier 52, a data extractor module 54, a control logic unit 56, a local clock 58, a serial number EPROM 60, a delay register 62, and a comparator and multiplexer 64. The fusible link 16 is also illustrated as is the protective component or guard ring 20.

In the circuit shown in Figure 7 components R1, R2, Z1 and Z2 and a sparkgap SG form an over- voltage protection circuit. The voltage between points C and D is clamped by the Zener diodes 21 and 22. A transistor Q1 is used to short the points C and D, drawing current through the resistors R1 and R2 during communication between the device 14 and a control unit - see Figures 8 and 9.

The bridge rectifier 52 rectifies the input voltage and stores energy in a capacitor C1 which corresponds to the capacitor 38 in Figure 2. The stored energy is used for operating the circuit after signalling has ceased.

The module 54 resolves the polarity of a signal connected to input terminals A and B of the device. Data and clock are imbedded into the signals to the detonator.

A Zener diode Z3 and a resistor R3 together with the logic unit 56 are used to clamp the input voltage, using a transistor Q2, below the no-fire voltage when the device is enabled. A resistor R4 and a transistor Q3 control the charging of a firing capacitor C2. A transistor Q4 keeps the capacitor C2 discharged until charging commences.

The bridge firing element 16 is fired by charging the capacitor C2 to above the designed no-fire voltage and by then turning on a transistor switch Q5 which corresponds to the firing switch 18.

The designed no-fire voltage is the voltage across the terminals A and B for, in use, a working voltage is applied to these terminals. The voltage which appears across the element 16 will be the same as, or slightly less than, the voltage across the terminals A and B.

The circuit shown in Figure 8 is substantially the same as that shown in Figure 7 save that a single capacitor C1 is used and the capacitor C2 is dispensed with. The device is tested and connected at the inherently safe voltage (Figure 1). To fire the device, a signal is sent to disable the clamp, the voltage is raised to above the no-fire voltage, and a fire command sequence is sent.

In both circuits the guard ring 20 is connected to the control logic unit 56 so that the integrity of the firing element 16 can be monitored. This is based on the premise that the guard ring, which is less robust than the firing element 16, is more sensitive to physical or mechanical damage than the firing element. Consequently if the device 12 is subjected to physical or abrasion damage during manufacture then the guard ring 20 would be broken before the firing element. Damage to the guard ring can be assessed and the device 12 can be discarded if the guard ring is fractured.

The EPROM 60 stores a unique serial or identity number assigned to the device 12. The number corresponds to or is associated in any desirable way with the bar coded number held on the label 50. The unique number enables the device to be addressed individually. The serial number can be interrogated. At power-up a read identity command causes the linked device to respond. An unlink message unlinks a device. Unlinked devices do not respond to a read identity

message. This replaces other addressing schemes eg daisy chain.

As has been indicated, the no-fire voltage of the device is established by prior testing of samples taken from a batch. The operating circuitry shown in Figure 7 is designed to be capable of operating over a range of voltages which straddles the no-fire voltage, see Figure 1.

The circuit 56 is capable of bi-directional communications with a control unit which is used to control a blast sequence. As has been indicated when the device 12 is interrogated, the serial number held in the EPROM 60 can be transmitted together with any other desirable preprogrammed data to the control unit.

The integrity of the bridge 16 is monitored indirectly by monitoring the integrity of the guard ring 20. Any damage to the guard ring is automatically reported to a control unit.

It is to be noted from Figures 2 to 5 that the device 12 is mechanically located in the header 32 and that additional circuit components are carried on the substrate 34. The flexible bonding wires 40 which connect the substrate to the header are a particularly reliable means of connection. The flexibility and light weight of the bonding wires reduce the chance of breakage and poor electrical contact. Such movement of the device 12 relative to the header 32 and the substrate 34 may occur during manufacture, handling and use in high shock environments.

The design of the device is such that an uncoded signal of up to 500 volts, whether AC or DC, cannot be used to fire the device.

Transient overvoltages up to 30kV will not initiate the device.

Figures 9 and 10 illustrate the use of a plurality of devices 10A, 10B, 10C, and so on, in a blasting system. Unique numbers, associated with the respective devices, are carried on respective labels 50A, 50B, 50C, and so on. The input leads 48 of each respective device are connected to a two wire reticulation system 80, in any polarity, with the connection order being as indicated in Figures 9 and 10. The serial numbers on the labels are random in that they have no correlation with the connection order.

The connection order in one mode of application is monitored by, and stored in, a first control unit 70 which is powered by virtue of its connection to a tester 77 which physically contains a power source (batteries) having a maximum voltage output well below the tested no-fire voltage of the electronic explosive initiating device, thereby ensuring inherent safety during connection of the blasting system in the field. Thereafter use is made of a second control unit 72 which assigns delay periods to the detonators, taking into account their connection order, but using the serial numbers as a means for identifying the individual detonators. This enables a desired blasting sequence to be achieved in a simple yet efficient manner.

The invention makes it possible to connect detonators in the field even though labels or other identity information of the detonators may have disappeared. To achieve this each detonator has unique internally stored identification data. In order to address a detonator one must have the identity of the detonator but, to obtain the identity, the detonator must be powered up. It is therefore necessary to have a detonator with which it is safe to work at a particular voltage.

The designed no-fire voltage is the voltage across the two terminals of the detonator. As stated the designed no-fire voltage is determined from samples and each detonator which is used in a blasting system is tested beforehand at a confirmation no-fire voltage to ensure that it can be used in the field at that

voltage. The operating and communicating voltages straddle the no-fire voltage. Also the detonator has the characteristic that, when powered-up, its identity data is available.

In the field, when the detonator is connected to a hamess, and a good connection is made, a signal is automatically generated to indicate that the connection is in fact in order. If a signal is not generated then a technician can re-make the connection immediately. There is consequently automatic testing of the integrity of the connection. The system automatically logs the temporal sequence of the connection. In a simple blasting system the temporal sequence can sometimes be equated to the geographical positions of the detonators. This however is not always necessary for positional information can be determined in any way, for example using a global positioning system which generates precise positional data which is transmitted to the control unit. It is therefore possible to make available sequential or temporal information, to obtain the identity data of each detonator, and to test the integrity of the connection of each detonator to a blasting system. Thereafter the control unit can be used, taking into account the detonator sequence, and the position of each detonator, to assign time delays to the individual detonators in order to achieve a desired blasting pattern.

The time delays can be generated using an algorithm or any appropriate computer programme which takes into account various physical factors and the blast pattern required.

As pointed out when a detonator is powered-up it is linked and specific information relating to that detonator can be sent to it from a control unit to enable the detonator to be programmed with time delay information. The detonator is subsequently unlinked and, in this state, together with all the remaining detonators in the system which are also unlinked, can receive broadcast messages, for example to fire the detonators.

At any time a detonator can be linked. This is achieved by sending the message down the line with the identity of the detonator in question.

A principal benefit of the invention is the inherent flexibility in the blasting system. As the integrity of each connection is monitored immediately remedial action can be taken on site as required. Each detonator can be identified even if external markings are obliterated. Sequential connection information, and identity data relating to each detonator, are available automatically. Position information can be generated with ease. Consequently there are no practical constraints in assigning time delays to the individual detonators, by means of a suitable computer programme or algorithm, to achieve a desired blast pattern.

Another significant benefit arises from the safety which is afforded to personnel installing the system. The screening which takes place, by testing off-site, at the confirmation no-fire voltage, the use of operating and communication circuits which function at voltages below the no-fire voltage of each device, and the ability of each device to "identify" itself, establish a high intrinsic level of safety in a blasting system.

CLAIMS

1. An electronic explosives initiating device which includes a firing element which has a designed no-fire voltage and an operating circuit which operates at any voltage in a range of voltages which straddles the designed no-fire voltage.

2. A device according to claim 1 wherein the designed no-fire voltage is verified by testing one or more samples taken from a batch of electronic explosives initiating devices which are designed to be substantially the same.

3. A device according to claim 2 which is tested at a confirmation no-fire voltage which is less than the designed no-fire voltage.

4. A device according to claim 1, 2 or 3 which includes a bi-directional communication circuit which operates at a voltage below the no-fire voltage.

5. A device according to claim 4 wherein the bi-directional communication circuit operates at any voltage in a range of voltages which straddles the designed no-fire voltage.

6. A device according to any one of claims 1 to 5 wherein the operating circuit, when connected to an operating voltage which is in the said range and which is below the designed no-fire voltage, is in a linked state in which identity data, pertaining to the device and stored in the circuit, can be logged.

7. A device according to claim 6 which has a label which displays a number or code which corresponds to or which is based on the identity data.

8. A device according to claim 6 or 7 wherein the operating circuit, when connected to the operating voltage, is responsive to an externally applied control signal by means of which the operating circuit can be switched to an unlinked state.

9. A device according to any one of claims 1 to 8 wherein the firing element is a bridge and one or more links which are physically less robust than the bridge are positioned adjacent the bridge and are monitored for mechanical damage.

10. A device according to claim 9 wherein the operating circuit includes means for monitoring the link or links and for rendering the bridge inoperative if mechanical damage to the link or links is detected.

11. A device according to any one of claims 1 to 10 wherein the operating circuit includes means for sensing the polarity of any electrical connection made to the device and for resolving the polarity of the connection.

12. A device according to any one of claims 1 to 11 which includes a sensing circuit which monitors a voltage applied to the device and which generates a warning signal if the voltage exceeds a pre-determined level.

13. A device according to any one of claims 1 to 12 which includes means for clamping a voltage which is applied to the device to a level below the designed no-fire voltage.

14. A blasting system which includes a plurality of devices, each device being according to claim 6 or 7, and at least a first control unit, which does not have an internal power source, to which the devices can be connected and which is adapted to record the identity data of each device connected to it in a predetermined order.

15. A blasting system according to claim 14 which includes a second control unit which is used to assign a respective time delay to each of the devices via the first control unit.

16. An electronic explosives initiating device which includes a firing element which has a designed no-fire voltage and which has been tested at a confirmation no-fire voltage which is less than the designed no-fire voltage, the device further including an operating circuit which operates at any voltage in a range of voltages which straddles the designed no-fire voltage, and memory means in which identity data, pertaining to the device, is stored, the operating circuit, when connected to an operating voltage which is in the said range and which is below the designed no-fire voltage, being switchable to a linked state in which the identity data can be accessed by external means.

17. A blasting system which includes a plurality of explosives initiating devices, each device including respective memory means in which identity data, pertaining to the device, is stored, and a respective operating circuit, control means, and connecting means, leading from the control means, to which each of the devices is separately connectable, the control means including test means for indicating the integrity of the connection of each device to the connecting means, when the connection is made, and storage means for storing the identity data from each device and the sequence in which the devices are connected to the connecting means.

18. A blasting system according to claim 17 wherein the operating circuit of each device, when the device is connected to the connecting means, is placed in a linked state which allows the identity data in the memory means to be accessed by the control means.

19. A blasting system according to claim 17 or 18 wherein the storage means includes means for storing positional information relating to each respective device.

20. A blasting system according to claim 17, 18 or 19 wherein the control means includes means for assigning time delays to each respective device.

21. A method of establishing a blasting system which includes the steps of connecting a plurality of explosives initiating devices, at respective chosen positions, to connecting means extending from control means, testing the integrity of each connection at the time the connection is made, storing in the control means identity data pertaining to each respective device and the sequence in which the devices are connected to the connecting means, and using the control means to assign predetermined time delays to the respective devices.

22. A method according to claim 21 which includes the step of storing positional information, relating to each respective device, in the control means.

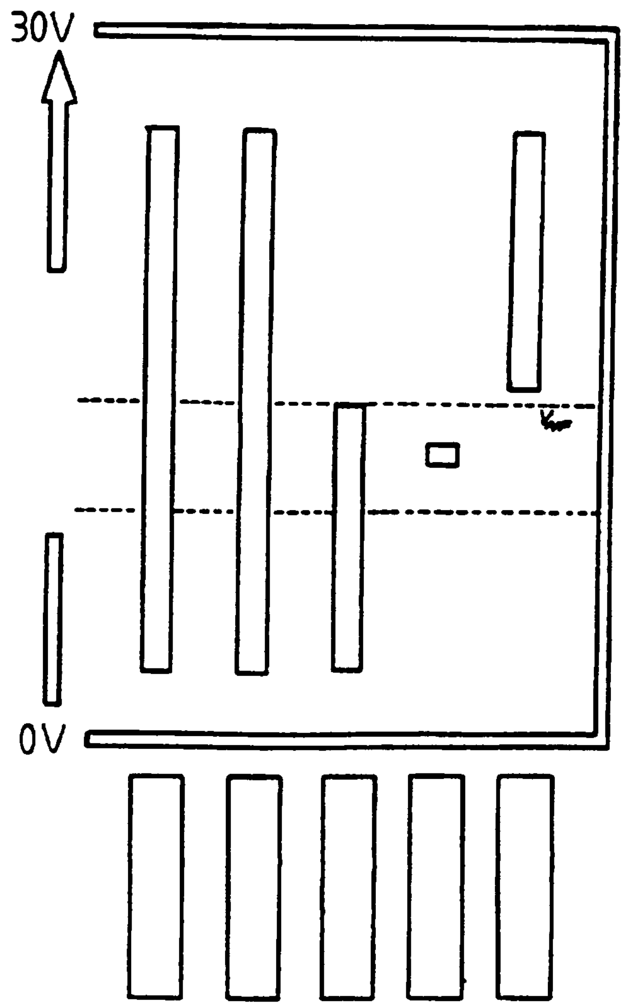

FIG 1

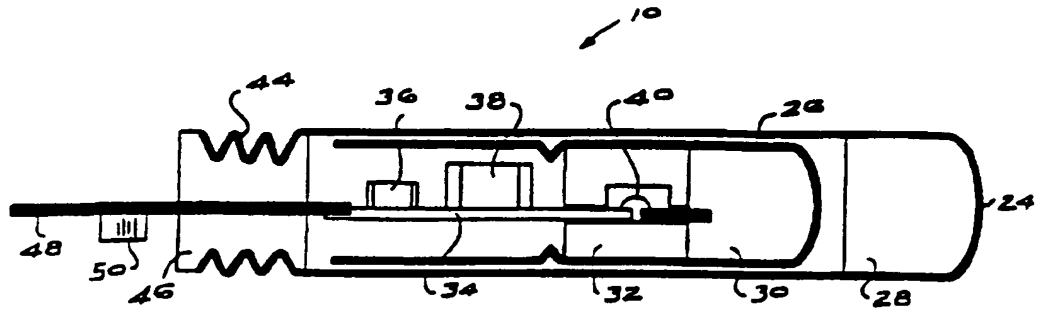

FIG 2

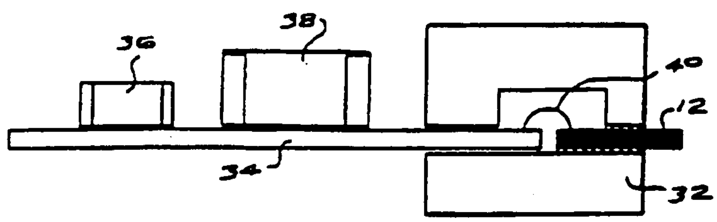

FIG 4

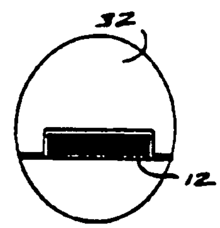

FIG 5

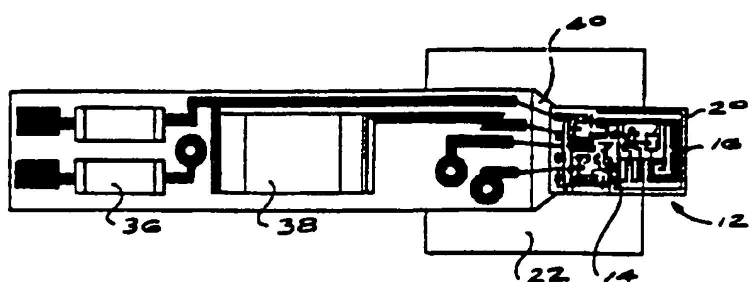

FIG 3

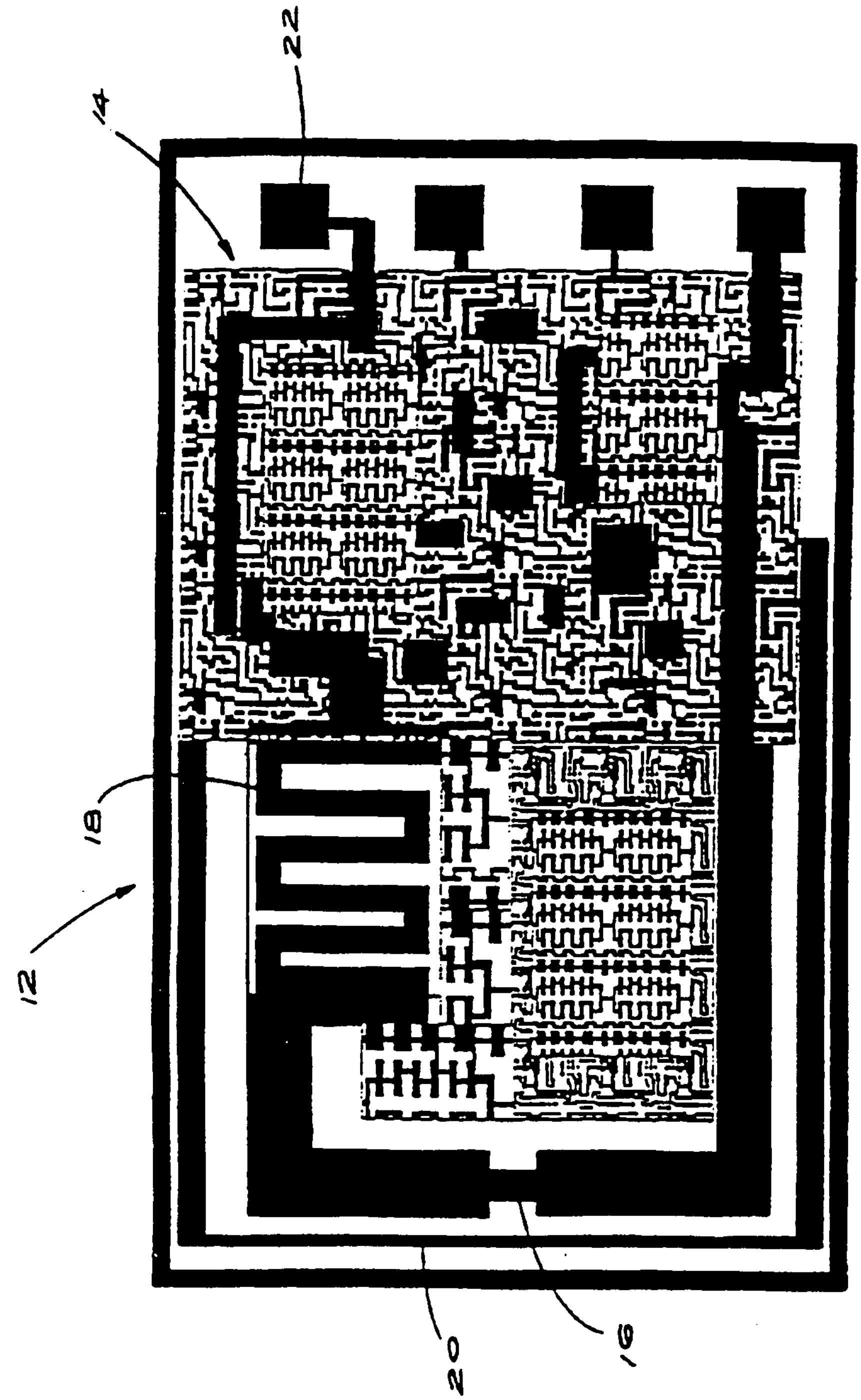

FIG. 6

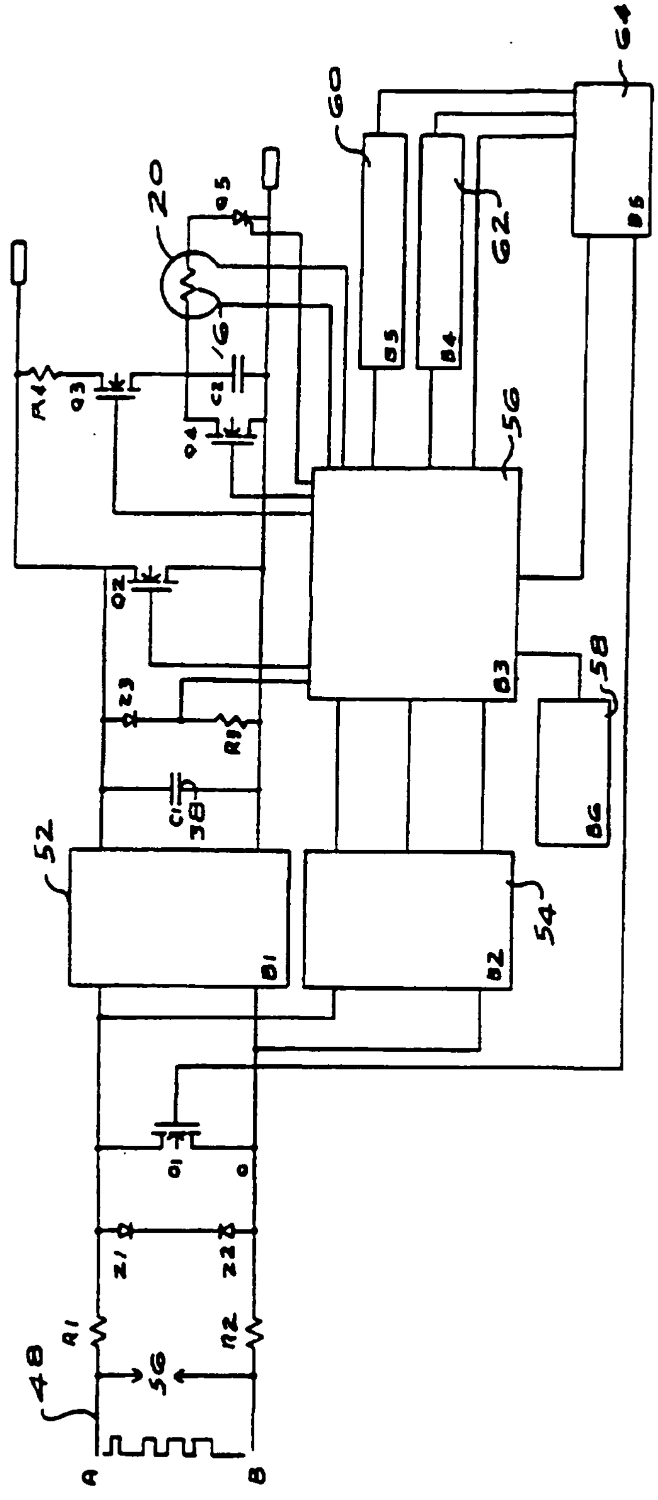
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Fig 7

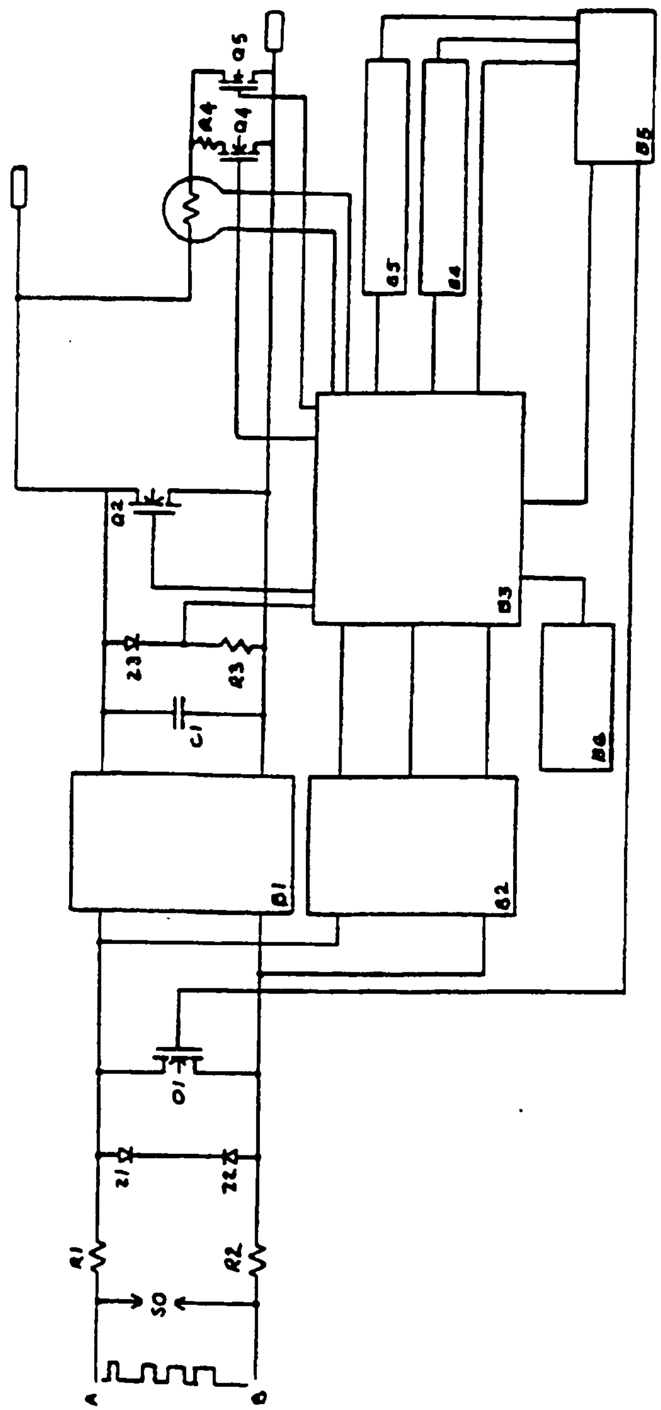
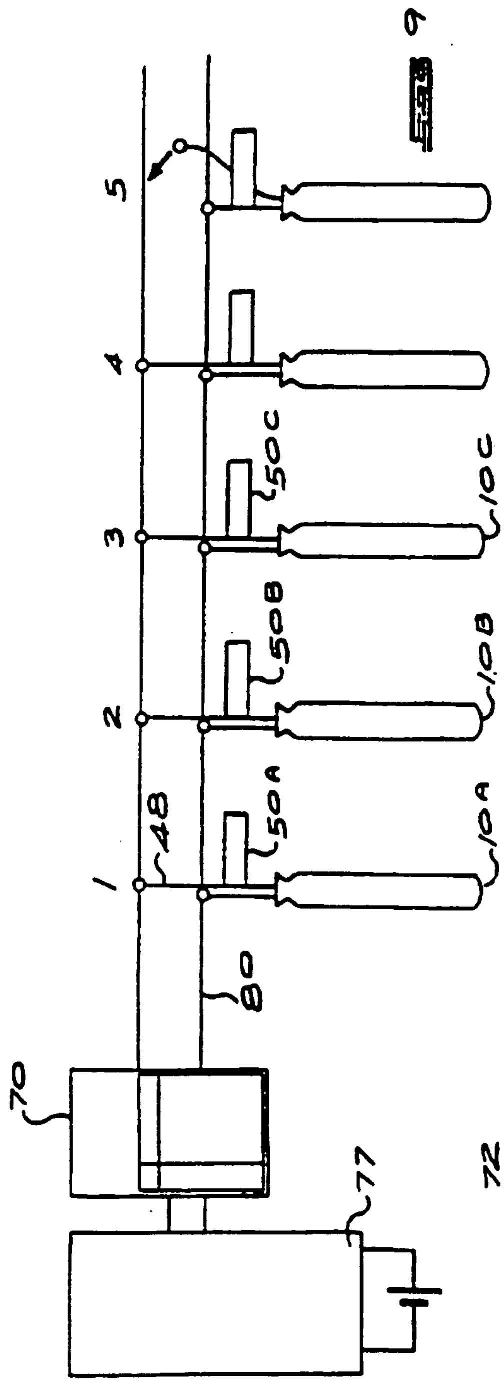


Fig 8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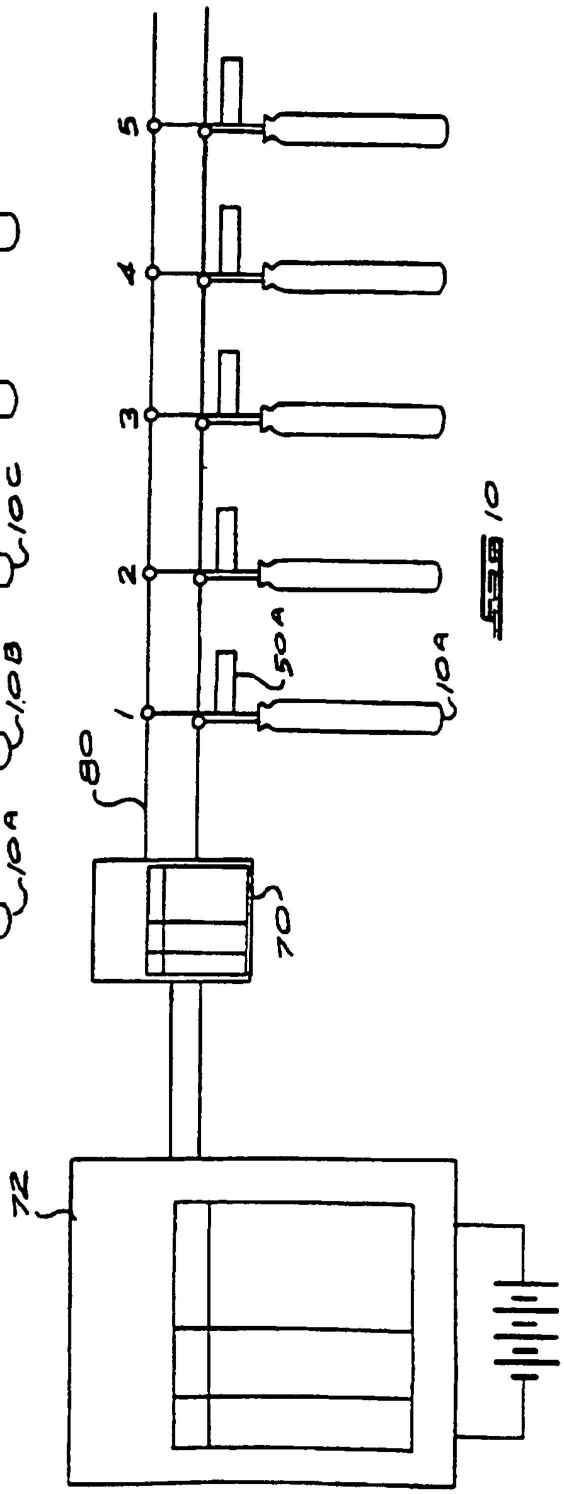
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INTERNATIONAL SEARCH REPORT

Intern   nal Application No
PCT/GB 96/02987

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   F42D1/05   F42B3/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6   F42C   F42D   F42B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 35 37 820 A (DYNAMIT NOBEL) 30 April 1987 see column 3, line 27-51; figures 1-4 see column 4, line 40 - column 5, line 11	1
Y		2-8, 11-16

Y	US 3 258 689 A (D. RESSLER) 28 June 1966 see column 1, line 33-45 ---	2,3
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

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Date of the actual completion of the international search	Date of mailing of the international search report
22 April 1997	07.05.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Van der Plas, J

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 301 848 A (ETI EXPLOSIVES) 1 February 1989 see page 2, line 31-61 see page 3, line 17-63 see page 4, line 15 - page 5, line 49 see page 6, line 7 - page 7, line 45 see page 9, line 12 - page 11, line 23; figures 1-8 see claims 10-13	4-8, 12-16,19
X		17,18, 20-22
Y	AT 302 136 A (SCHAFFLER) 15 August 1972 see the whole document	7
Y	EP 0 434 883 A (UNION ESPANOLA) 3 July 1991 see page 3, line 37 - page 4, line 38 see page 5, line 3-5	11
X		21
Y	US 4 674 047 A (L. TYLER) 16 June 1987 see column 5, line 3 - column 6, line 18 see column 7, line 49-56 see column 8, line 23-33 see column 8, line 45-63 see column 10, line 43-60 see column 11, line 32-46 see column 18, line 46 - column 19, line 31	19
A		4-8, 14-18, 20-22
A	FR 2 593 907 A (NOUVELLE CARTOUCHERIEDE SURVILLIERS) 7 August 1987 see page 6, line 13 - page 7, line 9	1
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A	EP 0 588 685 A (D. BICKFORD) 23 March 1994 see column 6, line 26 - column 7, line 24 see column 9, line 23-30 see column 11, line 24 - column 14, line 21; figures 1-2C	4-6,8, 14-16

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 601 831 A (CSIR) 15 June 1994 see page 3, line 53 - page 4, line 17 see page 5, line 52 - page 6, line 23 see page 6, line 51 - page 7, line 8 ---	21,22
A	WO 87 00265 A (MOORHOUSE) 15 January 1987 -----	

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